**Station 1: Experimental Design and Data Analysis**

(Cards: Experimental Design; Data Analysis)

1) An ecologist wants to investigate the effects of pollution on soybean plants. The scientist grows five groups of plants and exposes four groups to various pollutants. The fifth group is not exposed to any pollutant. The ecologist observes the condition and growth of all the groups of plants over a period of time.

A. What was the independent variable (IV) in this experiment?

Pollutants

B. What was the dependent variable (DV) in this experiment?

Condition and growth of the plants

C. What are two possible constants in this experiment?

Amount of sunlight and water, type of soybean plant

D. What is the control group in this experiment and why have we included the control group?

The fifth group, to make sure any changes in the condition / growth of the plants (DV) resulted from changes in the IV (pollutants)

2) What is the difference between a hypothesis and theory? Provide an example of each.

Hypothesis – an explanation based upon the results of an experiment

Ex: If plants are exposed to pollutants, than their growth will be lower than if no pollutants are present.

Theory – a widely agreed upon explanation based on a lot of scientific evidence

Ex: The cell theory (i.e. all living things are made of cells)

3) A scientist wanted to measure the effect of bananas on monkey belly size. Each day he measured the circumference of a monkey’s belly after feeding it two bananas. Over time, the monkey’s belly began to grow.

A. Which type of graph (line or bar) would the scientist use to track this trend and why?

A line graph because we are trying to track changes in the dependent variable over time. We are plotting a trend.

B. On which axis (x or y) would you put the belly circumference? Is this the dependent or independent variable?

Y axis ; dependent variable

C. On which axis (x or y) would you put the number of days? Is this the dependent or independent variable?

X axis ; independent variable (but not really… the bananas is also the independent variable

**Station 2: Biochemistry (The Molecules of Life)**

(Cards: Water Chemistry; Organic Compounds; Proteins and Enzymes)

1) Which molecule is the most abundant molecule in the human body?

Water

2) Properties of Water: what is the difference between cohesion and adhesion? Which accounts for water “sticking” to itself in a rain droplet?

Cohesion – water molecules sticking to each other

Adhesion – water molecules sticking to something else (i.e. any polar molecule)

Water sticking to itself in a rain droplet is a result of cohesion

3) Gatorade has a pH of approximately 2.9. Is Gatorade an acid or a base?

Acid

4) Which of the following is NOT one of the six most common elements in cells? – Sulfur, Potassium, Phosphorus, Carbon, Nitrogen, Oxygen, Hydrogen

Potassium

5) What is the difference between a monomer and a polymer?

A monomer is a building block of a polymer, which is a chain of monomers

6) Polypeptides (protein polymers) are made up of which type of monomer?

Amino acids

7) Which type of macromolecule (carbohydrate, lipid, protein, or nucleic acid) can speed up cellular reactions?

Proteins (a specific type of protein called an enzyme)

8) Each enzyme can only catalyze (speed up) a certain reaction. Why can’t an enzyme bind to every substrate?

The substrate fits into the enzymes active site like a lock and key

**Station 3: Cell Structure, Function, and Transport**

(Cards: Cell Theory; Types of Cells; Cell Structure and Function; Cell Activities and Homeostasis)

1) Which laboratory tools helped scientists like Hooke, Schwann, and Virchow develop the cell theory?

Magnifying lenses and light microscopes

2) What is the main difference between prokaryotic and eukaryotic cells?

Prokaryotic cells are smaller than eukaryotic cells

Prokaryotic cells do not have a nucleus or membrane-bound organelles (ex: chloroplasts, mitochondria, ER), but eukaryotic cells do

3) How is a plant cell different from an animal cell? Are these prokaryotic or eukaryotic cells?

Eukaryotic cells; plant cell has a cell wall (so a well-defined rectangular shape), chloroplasts, and a large central vacuole; animal cell has lysosomes and centrioles

4) Which organelle uses enzymes to break down old cell parts and digest food particles?

Lysosome

5) Which organelle is used to regulate the passage of materials into and out of the cell?

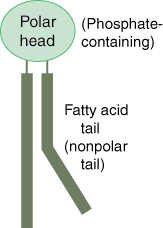
Cell membrane

6) Define homeostasis in your own words and explain how it relates to the cell membrane.

Maintaining stable internal conditions (ex: the cell membrane helps regulate water / salt balance inside the cell because it regulates the passage of these materials into and out of the cell)

7) Draw a picture of a membrane phospholipid and label the head and part. Which part of the phospholipid (head or tail) loves water, and which part fears water?

The head loves water and the tails fear water



8) What is the difference between passive and active transport? Is diffusion an example of passive or active transport?

Passive transport does not require energy to move substances, and active transport does

**Station 4: Cell Metabolism**

(Cards: Photosynthesis and Respiration)

1) During photosynthesis, autotrophs convert sun energy into which sugar molecule?

Glucose

2) During cell respiration, organisms convert sugars into a usable form of energy. What is this energy-rich molecule called?

ATP

3) Why is aerobic respiration (oxygen present) more efficient than anaerobic respiration (no oxygen present)?

It produces more ATP

4) What are the byproducts/waste products of anaerobic respiration?

Sometimes lactic acid and sometimes ethanol (aka ethyl alcohol)

5) In what organelle (cell part) does photosynthesis take place?

Chloroplast

6) In which part of a plant (roots, stem, or leaves) does most photosynthesis take place?

Leaves

7) In what organelle (cell part) does cell respiration take place?

Mitochondria

**Station 5: Cell Cycle and Division**

(Cards: Mitosis and Meiosis)

1) Why can’t cells grow forever? What do they do to solve this issue?

The membrane (surface area) does not grow as fast as the volume of the cell. A very LARGE cell has a very LOW surface area to volume ratio… it does not have enough membrane to transport materials efficiently. Large cells divide into smaller cells to solve this problem. This is why our body is made of trillions of tiny cells, not one huge cell.

2) What types of cells (body or gamete) are made during mitosis?

Body cells (aka somatic cells)

3) What types of cells (body or gamete) are made during meiosis)?

Gametes (aka sex cells)

4) Write the phases of the cell cycle in order: anaphase, cytokinesis, prophase, interphase, metaphase, telophase

Interphase, prophase, metaphase, anaphase, telophase, cytokinesis

5) How many daughter cells are formed during mitosis? Are they identical or different?

Two, identical

6) How many daughter cells are formed during meiosis? Are the identical or different?

Four, different

7) How many sets of chromosomes does a diploid cell contain? How about a haploid cell?

Diploid cell 🡪 2 sets of chromosomes

Haploid cell 🡪 1 set of chromosomes

8) Can a cell plate form during animal cell cytokinesis? Why or why not?

No, a cell plate is a new cell wall that forms between PLANT daughter cells

**Station 6: Genetics**

(Cards: Mendelian Genetics; Patterns of Inheritance)

1) Which of Mendel’s three laws states that each pair of homologous chromosomes arranges itself separately along the center of the dividing cell?

Law of Independent Assortment

2) Give an example of a homozygous genotype. (Use letters to represent alleles!)

AA or aa

3) Give an example of a heterozygous genotype. (Use letters to represent alleles!)

Aa

4) A flower can have pink or purple petals. Is the petal color an example of a genotype or a phenotype?

Phenotype

5) A blue alien mates with a yellow alien. Their babies are green. Is this an example of codominance or incomplete dominance?

Incomplete dominance

6) A blue alien mates with a yellow alien. Their babies are yellow and blue striped. Is this an example of codominance or incomplete dominance?

Codominance

7) What types of things could happen to a section of DNA that is mutated?

A single base could be switched (substitution)

A base could be added or taken out (insertion or deletion)

A chunk of the chromosome could be flipped (inversion)

A chunk of the chromosome could be copied (duplication)

Etc. etc.

**Station 7: Nucleic Acids and Protein Synthesis**

(Cards: DNA and RNA – Structure; DNA – Replication, Discovery; DNA Technology; Protein Synthesis)

1) Why do scientists call DNA a double helix?

It has two strands that wind around each other like a spiral staircase

2) What are the four types of nitrogenous bases, and which bases match together across the DNA double helix?

Adenine, Thymine, Guanine, Cytosine

A pairs with T and G pairs with C

3) What are two differences between a DNA and RNA molecule?

DNA has two strands and RNA has one

DNA has the sugar deoxyribose and RNA has the sugar ribose

DNA has the nitrogen base thymine and RNA has the nitrogen base uracil

4) What tool did Rosalind Franklin use to gather evidence for the structural model of DNA?

X-ray crystallography (aka x-ray diffraction)

5) How do scientists make recombinant DNA?

They take DNA from one organism and “stick it” into the DNA from another organism (ex: sticking the human insulin gene into bacterial DNA)

6) What does the Human Genome Project study?

The sequence of nitrogen bases in the human genetic code

7) Protein Synthesis: What happens during transcription, and where does it take place in the cell?

DNA is converted to mRNA; happens in the nucleus

8) Protein Synthesis: What happens during translation, and where does it take place in the cell?

tRNA “reads” mRNA to make a strand of amino acids (a polypeptide); happens in the ribosome (floating in the cytoplasm or attached to the rough ER)

**Station 8: Classification / Biodiversity**

(Cards: Classification; Viruses; Monerans, Protists, Fungi; Plants; Animal Kingdom; Classes of Invertebrates; Chordates and Vertebrates)

1) What traits can scientists use to see how related two organisms are to one another?

Structural similarities (comparative anatomy), comparative embryology, comparative biochemistry (DNA and amino acid sequences)

2) \_\_\_\_\_\_\_\_\_\_\_\_ is what we call the evolutionary history of an organism.

Phylogeny

3) What two molecules make up the structure of a virus?

Nucleic acids (either DNA or RNA) surrounded by a protein coat (a capsid)

4) Briefly explain what happens during the lytic (infection) cycle.

A virus attaches to the host cell and injects its genetic material (DNA or RNA), the host cell makes copies of the viral genetic material and protein coat, baby viruses burst out of the host cell (lysis) and the host cell dies

5) Which two kingdoms include unicellular prokaryotes? (Hint: these two kingdoms were once both in the Monera Kingdom)

Kingdom Archaebacteria and Kingdom Eubacteria

6) Which kingdom includes unicellular eukaryotes?

Kingdom Protista

7) Which kingdom includes multicellular, heterotrophic, eukaryotic organisms that obtain nutrients by breaking down materials outside their bodies?

Kingdom Fungi

8) Which animal phylum includes organisms that have an exoskeleton and jointed appendages?

Phylum Arthropoda

9) Which animal phylum includes organisms with a backbone (vertebrates)?

Phylum Chordata

10) List the following levels of organization within an organism from smallest to largest: organ, tissue, organism, cell, organ system

Cell, tissue, organ, organ system, organism

**Station 9: Ecology**

(Cards: Ecosystems; Ecological Change)

1) What is the difference between a biotic and an abiotic factor? Provide an example of each.

A biotic factor is a living thing (ex: a predator) that can affect another organism and an abiotic factor is a nonliving thing (ex: rainfall) that can affect an organism

2) What is a limiting factor?

Something that can limit the growth of a population

3) How is a density-dependent limiting factor different from a density-independent limiting factor? Provide an example of each.

A density-dependent factor limits the size of the population only when it is large (ex: a food shortage)

A density-independent factor can limit the size of a population regardless of its current size (ex: a hurricane)

4) How is exponential growth different from logistic growth? (Hint: analyze the graphs given on the Ecological Change card and use the term carrying capacity in your answer)

Exponential growth is rapid growth of a population over a short period of time

Logistic growth occurs over a long period of time with initial rapid growth and then the population levels off at the carrying capacity due to limiting factors

5) Given an example of each of the three symbiotic relationships:

A. Mutualism plants and their insect pollinators

B. Commensalism birds following cows

C. Parasitism tapeworms in human intestines

(Ex: in a mutualistic relationship between an insect and a flower, the insect benefits by receiving food, and the flower benefits by reproducing)

6) List the following ecological levels in order from largest to smallest: population, ecosystem, organism, biome, biosphere, community

Biosphere, biome, ecosystem, community, population, organism

7) Explain what occurs during two of the following parts of the water cycle: evaporation, transpiration, condensation, precipitation

Evaporation – water changes from a liquid to a gas

Transpiration – evaporation of water from plant leaves

Condensation – water changes from a gas (water vapor) to a liquid in the clouds

Precipitation – liquid water that has just been formed in the clouds due to condensation falls to the ground

**Station 10: Evolution**

(Cards: Evolution; Natural Selection)

1) How did Miller and Urey’s experiment help us to better understand the origin of life? (think lightning storms!)

They showed that simple organic molecules (ex: amino acids) that are found in cells today could be created by combining gases from early Earth’s atmosphere and energy (ex: a spark or lightning).

2) What causes genetic variation among members of a population? How might genetic variation help a population to survive a wave of the flu virus? (Hint: some organisms are naturally more resistant to the virus than others)

Genetic mutations cause variation among members of a population. If a population has high genetic variation, some members of the population may be genetically resistant to a virus and will be able to survive the virus, lowering the risk of the population going extinct.

3) Organisms with favorable traits for the particular environment will survive. What else do they have to do (other than survive) to pass their traits on to the next generation?

Reproduce

4) What is the difference between divergent and convergent evolution? (Hint: You can draw a picture. Look at your fill-in-the blank packet, bottom of page 24, for help with this question)

Divergent evolution – different species arise from the same ancestor due to different environments (ex: Darwin’s finches)

Convergent evolution – species from different ancestors become more similar due to similar environments (ex: sharks and dolphins)

5) What is a vestigial organ? Provide an example.

A structure that was used in the ancestor but is no longer used today (ex: the human appendix or the whale flipper)

6) What are homologous structures? (Hint: think of the similar limb bones we see in whale flippers, human arms, and bat wings)

Homologous structures are structures that came from a common ancestor but are used for different functions due to different environments

7) How can similarities in DNA and amino acid sequences help us to see the relationships between different species?

More similar DNA or amino acid sequences means species are more closely related to one another